REMARKS

Claims 7-18 are pending in this application, with claims 7-16 being presently withdrawn from consideration. By this Amendment, claim 17 is amended to further distinguish over the references cited in the Office Action.

No new matter is added to the application by this Amendment. Support for the language added to claim 17 can be found in FIG. 1 and in the present specification at paragraph [0029], as originally filed.

Entry of the amendments and reconsideration of the application are respectfully requested.

I. Rejection Under 35 U.S.C. §103(a)

Claims 17 and 18 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 6,042,958 to Denton et al. in view of U.S. Patent No. 6,437,011 to Steck et al. and WO 02/33709 (WO '709). The rejection is respectfully traversed.

The Patent Office acknowledges that Denton et al. fails to teach or suggest a thickness of the sheet embedded within (the sheet embedded portion of) the polymer matrix being between 30% to 80% of the entire thickness of the matrix (see page 4 of the Office Action). The Patent Office introduces Steck et al. and WO '709 as allegedly remedying the deficiencies of Denton et al.

Specifically, the Patent Office alleges that Steck et al. discloses that use of both woven and non-woven glass materials as a mechanical core or substrate for a proton conducting electrolytic membrane is known in the art. However, nowhere does Steck et al. teach or suggest a thickness of the sheet embedded within (the sheet embedded portion of) the polymer matrix being between 30% to 80% of the entire thickness of the matrix. Thus, Steck et al. fails to remedy the above deficiencies of Denton et al.

Moreover, the Patent Office alleges that Fig. 2 of WO '709 (assuming that the Patent Office is referencing the circled magnified portion in Fig. 1 of WO '709 instead of Fig. 2 as set forth on page 6 of the Office Action) suggests that it is known in the art that the fabric support is substantially less than the entire thickness of the matrix.

Contrary to the allegations by the Patent Office, Applicants submit that none of Denton et al., Steck et al. and WO '709, taken singly or in combination, teaches or suggests an electrolyte membrane that is intended for use in a fuel cell having an entire sheet that is implanted in the polymer matrix so that the surface of the electrolyte membrane is constituted of the polymer matrix and a thickness of a portion of the matrix that has the sheet embedded therein is between 30% and 80% of the entire thickness of the matrix, as recited in amended claim 17.

First, nowhere does the circled magnified portion of Fig. 1, any figures and/or the specification of WO '709 teach or suggest that a support thickness is substantially less than the entire thickness of the matrix as required in claim 17. To consider that the circled magnified portion of Fig. 1 of WO '709 teaches or suggests that the support thickness is substantially less than the entire thickness of the matrix as alleged by the Patent Office would ignore the content of WO '709's teachings as a whole.

Page 12, line 27 through page 13, line 3 of WO '709 (lines 3-13 of paragraph [0074] of the corresponding U.S. application US 2004/0044160 A1) teaches that (1) in the ultraviolet irradiation of the unsaturated monomer composition-impregnated or coated reinforcing sheet sandwiched by the two support substrates, air and an excess unsaturated monomer composition should be squeezed out, and (2) when the reinforcing sheet is used, as shown in Fig. 1 of WO '709, ultraviolet irradiation is carried out preferably while applying pressure between the two support substrates uniformly. To squeeze out and eliminate air and an excess monomer as described in WO '709, it is obvious to apply pressure to the two support

substrates, which in turn will squash down (squeeze) the reinforcing sheet and the monomer. When applying pressure to the two support substrates and pressing down in such a way, the reinforcing sheet contacts the support substrates and the thickness of the electrolyte is naturally equal to the thickness of the reinforcing sheet.

Second, although the circled magnified portion of Fig. 1 appears to illustrate that a layer of excess monomer exists on each side of the reinforcing sheet, this illustration is merely for convenience so as to make the embedded sheet and the monomer visually distinguishable in Fig. 1. Considering the entire specification as a whole, along with the descriptions regarding Fig. 1 of WO '709, it is clearly evident that the circled magnified portion of Fig. 1 does not particularly show or suggest that the support thickness is substantially less than the entire thickness of the matrix.

Third, nowhere does WO '709 teach or suggest a matrix-sheet configuration having the sheet embedded portion to be 30% to 80% of a portion of the matrix as set forth in claim 17. For the sheet embedded portion to be within the range of 30% to 80% of a portion of the matrix, a thickness of the electrolyte membrane needs to be 1.25 to 3.33 times the thickness of the support sheet. Thus, to achieve the sheet embedded portion to be within the range of 30% to 80% of a portion of the matrix, the thickness of the monomer that is used is in excess of 1.25 to 3.33 times the sheet thickness which is contrary to eliminating excess monomer by squeezing out as taught by WO '709.

Fourth, nowhere does WO '709 disclose or imply that the thickness of the support sheet may be 20% or more smaller than the thickness of the electrolyte membrane. Instead, WO '709 discloses that to reduce the amount of the monomer mixture attached to the reinforcing sheet and to make the polymer electrolyte (composite) membrane thinner, a low-boiling point solvent may be added as a diluent (see page 10, lines 25-27 of WO '709 or lines 5-9 of paragraph [0057] of US '160). WO '709 further discloses that the use of a diluent

contributes to the reduction of the amount of a resin attached to the reinforcing sheet in the order of one tenth or less (page 21, lines 9-10 of WO '709 or lines 4-6 of paragraph [0079] of US '160).

It is clearly evident from the disclosure of WO '709 that WO '709 teaches and suggests reducing the amount of the polymer used, which is contrary to the present disclosure. In other words, reducing the amount of polymer used in accordance with WO '709 teaches away from the matrix-sheet configuration of the present claims having both sides of the glass sheet covered by a polymer with an excess polymer applied so as to form a layer of the polymer on both sides of the glass sheet. Thus, WO '709 fails to remedy the deficiencies of Denton et al. and Steck et al. because WO '709 does not teach or suggest an entire sheet that is implanted in the polymer matrix so that the surface of the electrolyte membrane is constituted of the polymer matrix and a thickness of a portion of the matrix that has the sheet embedded therein is between 30% and 80% of the entire thickness of the matrix as recited in claim 17.

Fifth, Applicants submit, as set forth in the February 28, 2007 Amendment, that an electrolyte membrane with the required structure of claim 17 allows a fuel cell to be constructed having a structure in which "the portion of the electrolyte member 13 touching the anode 12 and the cathode 14 (i.e., the surface of the electrolyte member 13) is substantially constituted of the polymer matrix 13A," as shown in FIG. 1 and discussed in paragraph [0029] of the specification. Moreover, Applicants submit that a fuel cell having this structure has excellent conductivity between the electrolyte membrane and the electrodes.

Attached is a Declaration under 37 CFR §1.132 (Declaration) illustrating the criticality of having a thickness of a portion of a matrix that has the sheet embedded therein within a range between 30% and 80% of the entire thickness of the matrix to produce an electrolyte membrane that exhibits excellent conductivity and superior maximum power density and open circuit voltage.

The Table and Graph of the Declaration illustrate the relationships between % thickness of the embedded substrate (the sheet embedded portion) and a maximum power density (MPD) and open circuit voltage.

Maximum Power Density (MPD)

The Table and Graph of the Declaration demonstrate that when the % thickness of the embedded substrate is greater than 80%, the proton conductivity becomes lower and the MPD of the electrolyte membrane decreases significantly. For example, when the % thickness of the embedded substrate is 80%, the MPD for the electrolyte membrane is 101 mW/cm^2 and when the % thickness of the embedded substrate is 91%, the MPD is 88 mW/cm^2 (see the Table of the Declaration).

Additionally, the Table and Graph of the Declaration demonstrate that when the % thickness of the embedded substrate is less than 30%, the MPD for the electrolyte membrane decreases significantly due to methanol crossover. For example, the % thickness of the embedded substrate is 36%, the MPD is 102 mW/cm^2 and when the % thickness of the embedded substrate is 27%, the MPD is 78 mW/cm^2 (see the Table of the Declaration).

Thus, the Table and Graph of the Declaration demonstrate that the MPD for an electrolyte membrane having a thickness of a portion of a matrix that has the sheet embedded therein within a range between 30% and 80% of the entire thickness of the matrix is far superior when compared to MPD for electrolyte membranes having a thickness outside of the range between 30% and 80%, such as 91% and 27%.

Open Circuit Voltage (OCV)

The Table and Graph of the Declaration demonstrate that when the % thickness of the embedded substrate is (1) 30% or greater, inhibition of methanol crossover significantly increases and thus OCV is higher, and (2) less than 30%, inhibition of the methanol crossover is insufficient and thus OCV is lower. For example, when the % thickness of the embedded

substrate is 36%, the OCV for the electrolyte membrane is 0.61 V and when the % thickness of the embedded substrate is 27%, the OCV is 0.54 V (see the Table of the Declaration).

Thus, the Table and Graph of the Declaration demonstrate that the OCV for an electrolyte membrane having a thickness of a portion of a matrix that has the sheet embedded therein greater than 30% of the entire thickness of the matrix is far superior when compared to OCVs for electrolyte membranes having a thickness less than 30% of the entire thickness of the matrix, such as 27%.

Conclusion

Thus, the results illustrated in the Table and Graph of the Declaration demonstrate that an electrolyte membrane having a thickness of a portion of a matrix that has the sheet embedded therein within a range between 30% and 80% of the entire thickness of the matrix is critical to producing an electrolyte membrane having excellent conductivity and superior maximum power density and open circuit voltage when compared to electolyte membranes that do not satisfy the required range of between 30% and 80% as recited in claim 17.

Because these unexpected results are not taught or suggested by Denton et al., Steck et al. and WO '709, taken singly or in combination, these references would not have rendered the features of claim 17 obvious to one of ordinary skill in the art.

For at least these reasons, claims 17 and 18, are patentable over the applied references. Thus, withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

II. Rejoinder

Applicants further respectfully submit that, because claims 17 and 18 are in condition for allowance for the reasons set forth above, claims 7-16 should be rejoined and considered on the merits at this time. Thus, withdrawal of the Restriction Requirement and rejoinder of claims 7-16 are respectfully requested.

III. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 7-18 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,

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JAO:BCA/hs

Attachment:
Declaration under 37 C.F.R. §1.132

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